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**Unit 2 Test Practice – Calculations and Short Response: Biochemistry**

Ms. Ottolini, AP Biology

***Calculations – Directions:*** *Use these formulas and sample questions to help prepare for the calculations section of your test. There will be four calculations problems on your test.*

pH : pH = -log10[H+]

1. One liter of a solution of pH 2 has how many more hydrogen ions (H+) than 1 L of a solution of pH 6?
2. A solution that began at a pH of 4 has increased its hydrogen ion concentration by 100 times. What is its new pH?

Gibbs Free Energy : ΔG = ΔH – TΔS

1. An experiment determined that when a protein unfolds to its denatured (D) state from the original folded (F) state, the change in Enthalpy is ΔH = H(D) – H(F) = 46,000 joules/mol. Also the change in Entropy is ΔS = S(D) – S(F) = 178 joules/mol. At a temperature of 20⁰C (293 K), calculate the change in Free Energy ΔG, in j/mol, when the protein unfolds from its folded state.
2. During a laboratory experiment, you discover that an enzyme-catalyzed reaction has a *G* of -20 kcal/mol. If you double the amount of enzyme in the reaction, what will be the G for the new reaction?

***Short Answer - Directions:*** *Use these questions to help prepare you for the short answer portion of your test. Two of these questions will be included on the test. Because I am giving you the questions in advance, I expect you to be fully prepared to answer each question thoroughly and accurately.*

***Objective #2:*** You will be able to explain how key atoms are cycled between living organisms and the non-living components of their environment.

1. Choose two of the following six elements that are most common in living organisms – carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulfur. Describe the processes by which these elements enter living organisms and identify the macromolecules of which they are a part.
2. Living systems depend on the properties of water that result from its polarity and hydrogen bonding.

a. Most organisms are approximately 70% water. For example, the cytoplasm of a human cell is largely water, with dissolved solutes. Explain how the chemical properties of water make it an ideal solvent for living things (i.e. polar substances like glucose or ionic / charged compounds like NaCl).

b.The ability of organisms to maintain relatively stable cellular and body temperatures is also due in part to the properties of water that allow it to resist drastic temperature changes. Some organisms such as animals also undergo evaporative cooling when they sweat. Explain how the properties of water help cool the body during sweating.

***Objective #3:*** You will be able to describe how the structural properties of water make it essential to living organisms.

1. Carbonic acid and bicarbonate ion play a role in maintaining blood pH around 7.4.

a. Describe how carbonic acid and bicarbonate work together as a buffer to regulate H+ concentrations.

b. Identify the direction the reaction will proceed (left or right) if the pH of blood becomes too high (too basic) and explain your answer.

c. Explain why it is important that the pH of the blood stay within a small range. Discuss the effect of pH on blood proteins like enzymes.

**H2CO3 🡨🡪 HCO3- + H+**

Carbonic acid Bicarbonate

***Objective #4:*** You will be able to connect the structures of the four macromolecules—carbohydrates, lipids, proteins, and nucleic acids— to their unique functions in cells.

3. Explain how the **structure** of two of the macromolecules described below helps to determine their **function.** You may use diagrams in your answer so long as you fully explain them.

a. Proteins (you may want to discuss the four levels of protein structure)

b. Cellulose

c. A phospholipid molecule

***Objective #5:*** You will be able connect the structure of enzymes to their catalytic function in chemical reactions within living organisms.

1. Define activation energy for a chemical reaction and explain how enzymes affect the activation energy of reactions that they help catalyze? How are they able to do this? (*Hint: Discuss the induced fit model of enzyme / substrate interaction.)*
2. The hydrolysis (breakdown) of adenosine triphosphate (ATP) to ADP and P releases energy that can be used to fuel other reactions.
3. Is this process anabolic or catabolic? How do you know?
4. Is this process endergonic (+ΔG) or exergonic (-ΔG)? How do you know?
5. Does this process increase or decrease entropy? How do you know?
6. Draw an energy curve for this reaction showing time progressing from the reactants to the products on the x-axis and free energy on the y-axis. Label the “energy of the reactants, “energy of the products,” ΔG, and the activation energy for the reaction.